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ABSTRACT

One focus of a year-long study of West German apprenticeship was the conditions that are most supportive of learning on the job. The study design incorporated two distinctions that the Germans consider critical: manual versus white-collar occupations and size of training firm. Two occupations were studied--auto mechanic and "Industriekaufmann" (middle manager in an industrial firm). Twenty beginning and advanced apprentices were observed in large and small firms; and apprentices, their teachers, and workplace supervisors were interviewed. Four case studies were analyzed through use of a framework that consisted of four characteristics critical to assessing a workplace's potential as a learning environment: the mentor's role, the learner's role, the content to be learned, and the structure of learning. Four workplaces were analyzed as learning environments--a large auto repair shop, a small auto repair firm, a large industrial firm, and a medium-sized industrial firm. The case studies confirmed the value of attending to the mentor's role, the learner's role, content, and structure. Four needs for further research were identified: observation and interview data for tracking on-the-job teaching and learning; greater specificity, uniformity, and replicability in examinations of workplaces as learning environments; objective measures of what workers are learning; and exploration of how new workers process new experiences. (22 references) (YLB)

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LEARNING ON THE JOB

Apprentices in West Germany

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LEARNING ON-THE-JOB

Apprentices in West Germany

In her presidential address to the 1987 meeting of the AERA, Lauren Resnick (1987a) called attention to some critical differences between "Learning In School and Out." Drawing on recent research in "everyday cognition," she proposed that schools be reorganized to take greater advantage of the learning capacities people demonstrate outside of schools and to emphasize "adaptive learning;" i.e., the ability to continue learning efficiently after ceasing to be a student. The model she cited for this kind of learning is apprenticeship. However, she injected a widely shared misperception into her insightful and provocative analysis by claiming, "Those traditional apprenticeship activities seem to be precluded by the high-technology work environment" (p. 17).

It is true that apprenticeship is no longer a major form of education and employment training for youth in the United States; fewer than 300,000 apprentices are registered and they are predominantly in their mid-twenties or older. But West Germany's system proves that it was not outmoded by advancing technology and provides a laboratory for examining workplaces as learning environments. Currently more than 60% of West German youth between the ages of 16 and 19 are apprentices, spending roughly four days per week learning on the job and one day a week in school. The "dual system" of apprenticeship combined with part-time vocational schooling is the largest component of the upper-secondary educational system, enrolling more youth than either college-preparatory Gymnasien or full-time vocational schools. Employers' faith in the utility of apprenticeship is demonstrated unmistakably by their willingness to pay for all the costs associated with workplace training, including apprentices' stipends. Male and female apprentices are trained for

traditional trades, manual industrial occupations, and a wide range of service occupations, more than 300 different occupations. (For a fuller description of West German apprenticeship, see Hamilton, 1987.)

This paper will explore the question, "What conditions are most supportive of learning on the job?" by drawing on the author's year-long study of West German apprenticeship, which included observations of 20 apprentices in their workplaces and vocational schools, and interviews with them and with some of their teachers and workplace supervisors. (It is an abbreviated version of a paper written for the U.S. Department of Labor that includes American cases: Hamilton & Hamilton, 1989.)

The German study's design incorporated two distinctions that the Germans consider critical: manual vs. white-collar occupations; and size of training firm. Two occupations, auto mechanic and Industriekaufmann (loosely, middle manager in an industrial firm) were selected and apprentices in each occupation were observed in both large and small firms. In addition, both beginning and advanced apprentices were observed. The Industriekaufmann occupation was selected in part because it enrolls approximately equal numbers of female and male apprentices; both were observed. Each of the four case studies below represents one of those situations.

A FRAMEWORK

Four characteristics are critical to assessing a workplace's potential as a learning environment. They will provide a framework for analyzing the cases.

A) The Mentor's Role

Teaching informally on the job is often designated mentoring. Hereafter we shall use the term, "mentor," for that role. A growing literature on

mentoring in the workplace has, to date been confined to executive-level employees, whose technical competence is assumed. As a result, the mentor's contribution to boosting a career and the disadvantages to women who lack powerful mentors as "sponsors" have been key issues (Zey, 1984; Kram, 1985). Because the term is current and appears more suitable than teacher, which conjures up a classroom, we will broaden it to include on-the-job teachers of workers at all levels.

The minimum criterion is that someone be available as a mentor. Simply putting a new person to work and allowing them to sink or swim is inadequate. Beyond that, there are a number of different things a mentor might do. Although they may be separated for analysis, they are likely to be performed simultaneously. The list includes the following mentor behaviors.

1) Instructing the learner in how to perform a task.
2) Demonstrating how to perform a task.
3) Coaching the learner as s/he performs the task.
4) Explaining why a task is performed a certain way.
5) Challenging the learner to perform well.
6) Initiating the learner into the culture of the work organization.
7) Affirming the learner's value as a person and talent as a worker.

A mentor may be formally assigned responsibility for a new worker or may simply acquire the role as a result of personal chemistry. One mentor may take a wide range of responsibilities or share them with others.

Instructing means telling. For present purposes, it is limited to orally telling an apprentice what or how to do something.

Demonstration is often labelled "modeling," (Resnick, 1987b) but a different word helps to avoid the confusion introduced by applying the

favorite term of social learning theorists to a much narrower set of activities. Bandura (1988) even defines written instructions as a form of modeling. Here it means the mentor actually performs a task as an aid to an apprentice's learning, which Bandura considers vicarious observational learning.

Coaching places the apprentice in the active role, doing the task, with the mentor watching and helping. Coaching is distinguished from instructing by the apprentice's activity. By this definition, an apprentice is listening when receiving instruction but working while being coached. For Resnick (1987b), this is providing "scaffolding." For Bandura (1988) it is observational learning through other's judgments.

Explaining why is a special form of instruction that deserves separate attention because of its importance to learning more than how to perform a particular task. One of the ways it is accomplished is by "thinking aloud" (Resnick, 1987b; Bandura, 1988); i.e., the mentor verbalizes the reasons for doing things a certain way, sometimes while demonstrating or coaching.

Bandura is particularly concerned with learning general principles rather than specific knowledge or skills. He calls this process, "abstract modeling."

> Through the process of abstract modeling, observers extract the rules underlying specific performances for generating behavior that goes beyond what they have seen or heard. In abstract modeling, judgmental skills and generalizable rules are being learned by observation. (1988, p. 100)

Challenging is a mentor function that is found in the literature on mentors for executives (Zey, 1984; Kram, 1985) and in research on mentors for youth by Bronfenbrenner and his colleagues (Hamilton & Darling, in press). An optimal challenge is one that stretches the apprentice beyond his or her

current capabilities without exceeding them to the point of frustration. (This notion will be developed below in relation to "structure.")

Initiating an apprentice into the culture of a workplace may be accomplished by any or all of the above methods, but it has a different focus. Rather than the technical nature of the work, it refers to the apprentice's learning about the workplace as a social system and where she or he fits in.

Affirming refers to the mentor's supportive role (Hamilton & Darling, in press). Bandura (1988) and Resnick (1987b) refer to it as motivating. Like initiating, this may refer to the apprentice's sense of self in the social system, but it also applies to the technical nature of the work. The mentor's assessment of work quality is an important source of an apprentice's feelings about him or herself as a worker.

B) The learner's role.

Each of the mentor functions listed above entails a complementary function on the learner's part. Dewey's principle of interaction makes this point. Interaction designates the two-way influence between a person's internal state and the external conditions in which she or he exists: "An experience is always what it is because of a transaction taking place between an individual and what, at the time, constitutes his environment" (1938, p. 43). In other words, the nature and impact of an experience cannot be determined solely on the basis of its "objective" qualities because it depends equally on the "subjective" state of the person having the experience. One implication of this principle is that no two people have literally the same experience at the same time. Although they are both involved in the same event, each one experiences it somewhat differently depending upon individual traits and previous experiences that interact with the event.

Educationally, this means that learning cannot be assured by arranging the external circumstances: the subject matter, the setting, and teaching methods. The same situation may provide a learning experience for one person but nothing new for another because each brings something different to the situation. Bandura (1988) tells us that a mentor cannot be effective unless a learner is attentive, retains what was taught, and is sufficiently motivated to apply the lesson.

However, because in practice the list of mentor functions must be matched by the apprentice's reciprocal function, there is little value in separating them. With regard to the learner's role, we shall focus on the relative emphases on learning and working. Informal on-the-job training, by definition, is merged with work. However, different balances can be struck between work and learning. Work demands that overwhelm learning opportunities are the obvious danger, but the opposite extreme is conceivable: an overly passive learner-only role that replicates some of the worst features of conventional classrooms. An optimal balance is to be sought. The cases will help identify what that optimum might be.

C) The content to be learned.

In order for a new worker to perform the tasks associated with a job, she or he must learn the requisite knowledge and skills. This technical content is usually what is closest to the surface in job training programs and conveyed most explicitly in informal training. However, there is a second type of content that comprehends the formal and informal rules of social interaction and the set of norms and customs that can be called the culture of a firm. One of the key functions of mentors for new executives is to make explicit critical aspects of a firm's or profession's culture that might

otherwise remain hidden.

Technical knowledge and skills may be taught rather superficially, as they are in fast food restaurants. In order to adapt to remarkably high turnover rates, they routinize every procedure so that employees can perform them with no more than a few seconds' training. The opposite end of the spectrum is found in high-quality apprentice training, where the goal is for the learner to understand the principles underlying his or her task performance so that it may readily be adapted to many different situations. At this end, which is the one we are concerned with here, manual skill is not enough; problem-solving and other higher-order thinking skills are also required. Both technical and social content may be ordered on a spectrum from low to high-level. The most promising learning environments lead apprentices beyond low-level content to higher levels.

Sylvia Scribner (1984) concluded an essay describing her pathbreaking research on the cognitive skills of dairy workers with a proposition: "Skilled practical thinking is goal-directed and varies adaptively with the changing properties and changing conditions in the task environment" (p. 39). Such "adaptive thinking" is certainly as appropriate a goal for teaching in the workplace as it is for schools.

D) <u>The structure of learning</u>.

"Structure" here refers to how and under what conditions learning occurs. The three key issues with regard to structure are sequencing, related instruction, and connections between work and learning. Dewey's principle of continuity calls attention to the need to make demands on a learner that are consistent with what she or he has previously experienced. Continuity refers to the fact that people are cumulatively affected by the experiences they

acquire over time: "every experience influences in some degree the objective conditions under which further experiences are had" (Dewey, 1938, p. 37). The principle of continuity yields a criterion; namely, that an experience is valuable when it enables the person to acquire additional constructive experiences, to continue growing and learning (p. 38). Learning experiences, to put the point in contemporary terms, are enabling or empowering; they are useful not only for immediate purposes but as steps toward more distant desired ends. The point may be more powerful in its negative implications. An experience is mis-educative when it hinders further learning. Thus, a person who learns to operate a machine by rote, without understanding the reasons for each procedure, will only be able to operate the machine so long as nothing goes wrong. Such a learning experience is not as valuable as learning at the same time why the machine should be operated in a particular way because knowing why enables the person to solve problems and to adapt to changes in the machine or in production processes.

There is another principle operating in the opposite direction, which is that the tasks to be performed must be sufficiently different from what the learner has done before to be challenging. This notion has been stated well by Vygotsky (1978) as "the zone of proximal development," that is, the arena in which a person's capacities enable one to perform well enough to avoid frustration but not so well as to constitute mastery. Bronfenbrenner (1979) has elaborated this notion by hypothesizing that development is facilitated by "progressively more complex patterns of reciprocal activity" with others (p. 60) and by an optimal "balance of challenge and support," (p. 288).

Continuity means that learning experiences are related to each other, something that is most likely to happen when opportunities for reflection are

systematically available. A progressive sequence of learning opportunities, in which each builds on the preceding one, entails some overall planning and direction of on-the-job training. Thus, even in on-the-job training, there is wide latitude for planned as opposed to incidental teaching and learning.

Because some of the knowledge and skills required in a workplace may be most thoroughly and efficiently learned in a classroom setting, another structural concern is the availability of supplemental instruction, which is called "related instruction" in U.S. apprenticeship programs. As with mentoring, the first issue is whether there is any. A second is whether it is of high quality.

Whether and to what extent related instruction is connected with the work experience and on-the-job learning determines its value. A further extension of this issue, suggested by Dewey's principles of continuity and interaction, is the connectedness between a worker's learning on the job and previous learning. An apprentice machinist who has learned math well in school is much better able to take advantage of on-the-job learning opportunities and related instruction than one who has to try to make up for lost time.

Dewey's notion of reflection is also related to connections.

> To reflect is to look back over what has been done so as to extract the net meanings which are the capital stock for intelligent dealing with further experiences. It is the heart of intellectual organization and of the disciplined mind. (p. 87)

The importance of reflection is derived from an examination of purpose and of the progressive organization of subject matter. The process of reflection helps the learner to make connections between previous learning and new learning experiences on the job.

Figure 1 presents the framework in outline form.

Figure 1
Elements of Workplaces as Learning Environments

A. The Mentor's Role

1) Instructing
2) Demonstrating
3) Coaching
4) Explaining
5) Challenging
6) Initiating
7) Affirming

B. The Learner's Role

1) Learner responses to the seven functions of the mentor's role
2) Balance between work and learning

C. Content

1) Technical
2) Social

D. Structure

1) Progressive sequencing
2) Related instruction
3) Connections

WORKPLACES AS LEARNING ENVIRONMENTS

A Large Auto Repair Shop

West German auto manufacturers operate some of their own sales and repair firms. This one, located in a large city, is as different from a corner gas station as a shopping mall is from a neighborhood variety store. On a typical day, it services 160-180 automobiles and trucks.

Large firms have sufficient resources to employ full-time trainers and provide their apprentices with a more thorough training program, including firm-based instruction. Apprentices in this firm do not begin to work on automobiles right away, as they do in smaller shops. Instead, they spend their first eight months working mostly in the firm's training shop, learning

basic metal working skills and worker virtues: "precision, cleanliness, and order" in the words of the training supervisor. During that time, they end each day by helping the mechanics clean up the repair shop, but otherwise spend little time near automobiles.

The observation recorded in the following field notes was made when the first-year apprentices had just moved into the repair shop. They worked in the regular maintenance section, in groups of five or six under the direction of a single skilled mechanic.

> The shop floor is divided into sections for different types of repairs: regular maintenance, electrical, paint and body, accident, and trucks. There is a large machine shop. Specialized tools are checked out of one room, parts and supplies from another. All vehicles must pass inspection in the testing section before being returned to their owners. White-collar supervisors in a glass-enclosed office elevated above the shop floor coordinate the flow of vehicles, time the work, dispatch service orders through pneumatic tubes, and direct the mechanics to their next jobs. Supervisors wearing neckties under light blue shop coats walk about carrying clipboards, checking on the work being done and answering questions. Each mechanic belongs to a work group with a leader who receives the instructions from the elevated office, either in writing or via the intercom.

At 18, Dieter Rentz is older than most first-year apprentices because he attended a commercial school (Wirtschaftschule) before changing his career choice. He is taking his first turn in the repair shop, in the regular maintenance section with four other apprentices and a journey worker group leader. His assignment is to replace the brake pads on an automobile as part of its 20,000 km. service. When I arrive to observe Dieter, he is trying to replace a disc brake. Unsuccessful, he goes to the group leader who, when he is finished with other business, asks, "Problem?" Dieter takes him to the workbench and shows him the balky bearing. The leader says it is in as far as it goes, then explains how it fits and tells Dieter to clean the gear teeth before installing it.

> After reassembling the disc brake unit, Dieter tries to replace it on the auto's axle spindle, but each time the bearing pushes out. When he can't find his group leader, another apprentice working nearby comes over and shows how to hammer the bearing into place. As Dieter does this, the group leader appears and tells him what to do to make the bearing go on more easily. The bearing in place, Dieter goes to the tool room to get a precision measuring device that gauges the tightness of fit between the brake disc and axle spindle. After measuring and adjusting for about eight minutes, he discovers that the wheel cannot spin on the axle regardless of how he adjusts it.
>
> The leader comes by and diagnoses the situation. He sends Dieter to the tool room for emery cloth and uses a strip of it to smooth the axle spindle, then quickly mounts and adjusts the brake disc. He then gives Dieter instructions for the remaining work, saying, "don't forget" for emphasis. Dieter replaces and adjusts the brake disc on the opposite wheel in about five minutes, then has the group leader check the wheel before filling and installing the grease cups that cover the ends of the axle spindles. Finally, he attaches the brake calipers.

As he moves to the next job, the rear wheel brakes, the pattern continues: the group leader is usually nearby and frequently checks Dieter's work. Other apprentices also lend a hand, share tools, or give advice. Dieter appears to understand what needs to be done and to be able to do the work. He has obviously done it before. In fact, the repair shop is organized to assure that work is repetitive. By now he needs no help to do the relatively routine tasks. It is when things do not work the way they are supposed to that he calls on the group leader.

A. Mentor's Role

The group leader was Dieter's mentor on the job. He performed the first four teaching functions. He verbally instructed Dieter in how to make the bearing fit. He demonstrated what to do by using the emery cloth himself. And he coached Dieter while Dieter was performing the work. His explanations were not extensive, but sufficient to give Dieter an understanding of why this smoothing operation was needed. In addition to demonstrating specific tricks

of the trade the group leader also demonstrated a problem-solving process. Note that the group leader did not perform those functions separately. Instead, they were intermingled, as when he explained what he was doing and why while smoothing the wheel spindle with the emery cloth ("thinking out loud").

The group leader was not the only mentor. Another apprentice did some teaching too. Although this particular effort was misguided -- the method the other apprentice recommended did not work -- it is common for learners to help each other in this manner. Two other mentors were not present, but were quite important to Dieter's apprenticeship: the two full-time instructors who worked in the training shop. The allocation of mentoring responsibility in this large shop is notable. Rather than the traditional matching of one apprentice with one journey worker, there was greater specialization of roles and, during the apprentices' introduction to the repair shop, a group arrangement.

B. Learner's Role

Apprentices exemplify the ideal mix of the worker and learner roles. Especially in large shops like this one, their primary purpose is to learn. Involvement in productive work is a means to that end. They are not expected to be as independent or to work as fast as skilled workers. Their supervisors readily spend time teaching them. The strongest evidence that Dieter and his colleagues were learners first is the extended time they spent in the training shop engaged in no productive work.

C. Content

What was Dieter learning here? He had already learned by this time how to perform the basic tasks in routine maintenance, but he was expanding that learning in two ways. First, as has been noted, he was learning what to do in

unanticipated circumstances. As Perkins and Salomon (1989) pointed out, high-level expertise is demonstrated more by the solution of new problems than by the competent performance of routine tasks. The observation period was too short to determine whether Dieter learned from the group leader only how to use emery cloth to smooth a grooved spindle when the bearing won't work properly (imitation) or whether he will be able to replicate the group leader's problem-solving process and come up with a novel solution under different circumstances (abstract modeling).

No learning about the shop's norms was observable from the immediate situation, but some intended goals in this realm were identified in an interview by the training supervisor. He stressed that the firm was not satisfied with competent performance of tasks. They demand speed as well. He explained that his job involved keeping constant pressure on the apprentices to learn to work quickly. He never explained why, but the answer is not hard to infer. Auto repairs are ordinarily billed to the customer according to a table giving standard amounts of time needed to perform specific tasks. The mechanics' hourly rate is fixed. Therefore, the amount the customer pays is standardized for a given procedure. If a mechanic can perform the procedure is less time, the difference between the charged time and actual time is pure profit. Most shops share this profit with their mechanics as an incentive bonus. Learning how to work quickly entailed, in addition to knowledge and skill, a diligent attitude.

Dieter and his work were embedded in a relatively complex organization, whose social structure he would have to understand in order to work effectively. Although never raised explicitly as questions or taught as lessons during my observations, Dieter might have asked, "Who are these men

with neckties and light blue shop coats who carry clipboards?" Over time he could see them acting as supervisors, inspectors, and participants in group problem-solving. He would learn that they had started as apprentices and worked as mechanics before earning promotion to their present positions, usually after additional formal instruction as well.

Another question worth pondering was, "What happens if the auto I repaired fails the inspection?" Although it never happened in my sight, he would discover whether and to what extent this involved personal humiliation and how negatively such an occurrence would be viewed by supervisors. Going with him to the parts and tools section to pick up some emery cloth, I was able to observe along with Dieter that this was one of the few places in the shop where "goofing off" was acceptable. Because there was usually a queue of mechanics waiting for the tools or parts they needed, this section of the shop was ideal for relaxing a bit, smoking a cigarette, talking, joking, and horsing around.

Note that he could learn about the firm's social structure and norms without the services of a designated mentor. Other workers informed and modeled, but no one in a formal instructional role "initiated" Dieter by speaking of these matters in my presence.

D. Structure

In this shop, the apprentices' learning was carefully structured. Its size afforded considerable specialization and division of labor. Apprentices followed a carefully planned program of experiences. After their time in the routine maintenance section, they were rotated systematically through other sections, with periodic returns to the training shop to learn specific skills, such as welding. By the conclusion of his training, Dieter would have worked

at a number of different kinds of auto repair, each time under the supervision of a skilled mechanic, and always having the support and oversight of the apprentice supervisor.

West Germans refer to the "dual system" of apprentice combined with part-time vocational schooling (Berufsschule). All apprentices attend school, usually one day each week. Their classes are directly related to their work experience. Dieter enjoyed the additional advantage of classroom instruction and work in the instructional shop on projects designed to teach basic metal working skills. One source of connections between work and related instruction is the qualifying examination that must be passed in order to achieve certification as a skilled worker. Both classroom and on-the-job learning are tested.

This shop was exemplary as a learning environment. It substantiates the expectation that large firms are able to provide higher quality training than small firms. Let us look next at a small auto repair shop to test this generalization.

A Small Auto Repair Firm

Erik Thoma, a 17 year old first-year apprentice, was an apprentice in a small garage where Toyotas are sold and serviced. The building was once a gas station; the pumpless islands stand amid an assortment of new and used cars. The owner's wife presides over the office, assisted by one other clerical worker. There are three service bays, but when weather permits work is also done outside. A narrow room between the office and the shop that is lined with shelves holding boxed parts serves as the coffee break and lunch room for the mechanics and apprentices. In addition to the owner, who is the shop's Meister, and two office workers, the firm's employees include four journey

workers, two apprentices, and a salesman.

When I arrive at 9:00 o'clock, Erik is out buying food. Upon his return a few minutes later, Brotzeit, the morning coffee break, begins. An older journey worker notices that Erik is not eating and asks him why. When Erik says he forgot to bring anything, the man leads him away and Erik returns with a sandwich, presumably a gift. Before the break has ended, Erik is called outside, where he removes the license plates from a Mercedes and hands them over to a woman who drives off in a new Toyota. The Mercedes, I infer, was her trade-in. Two of the mechanics start the engine after she has gone, and drive it a few feet forward and back, apparently out of curiosity.

After returning to finish Brotzeit, Schmidt, the journey worker with whom Erik works, gives Erik instructions on what to do with the rear brakes of a four-wheel drive Land Cruiser that stands elevated on a lift. While Erik begins removing the brake assembly, Schmidt comments and gives instructions. When the time comes to replace the brake drum, it won't fit. Erik asks for advice and Schmidt responds, then watches as Erik struggles unsuccessfully again before spotting the problem and making an adjustment that solves it. After they repeat the process for the other wheel and adjust the brakes -- Erik operating the brake pedal while Schmidt makes the adjustments -- the Meister comes by and looks underneath, pronouncing the task finished.

As Erik remounts the wheels, a mechanic working outside calls his name. He replies, "right away," and walks briskly outside as soon as he has finished tightening the lug nuts. He helps as the mechanic removes a suspension part, then comes back inside and lowers the Land Cruiser.

Discussing the next task, Schmidt says the Land Cruiser needs a new exhaust pipe. Erik says he didn't know that and raises the vehicle again on the lift. Both inspect the muffler and pipe, poking at the muffler with a screwdriver to see how badly corroded it is. Schmidt announces, "complete," but then is uncertain whether there is a complete exhaust system in stock. As Schmidt goes to find out, Erik brings over a small welding rig and replaces the tools used before. He then bums a cigarette from the mechanic working at the next bay. After five minutes, Schmidt calls him and shows that he has only the rear section of the exhaust system. Using the welding torch and an electric grinder, the two cut off or break the badly rusted bolts connecting the exhaust system.

Erik is called away for 20 minutes to help two other mechanics. When he returns, he carries the old pieces of the Land Cruiser's exhaust system to a scrap container. Then he and Schmidt lift the new section into place. They remove a hanger and experiment with different ways of attaching the hanger and connecting the pipe. The mechanic working outside comes in to say he needs Erik's help but

Schmidt says he can't go. The Meister goes out to help instead. The remounting of the exhaust pipe and muffler proceeds with numerous trials and several repetitions of the same connection. Erik tries to bend an L-shaped connector on the pipe so that it lines up with a bracket on the body. Another mechanic comes along and bends the bracket instead, which solves the problem. As lunch time arrives, the Meister comes by and approves the job.

A. Mentor's Role

Herr Schmidt functioned as Erik's mentor. He instructed, demonstrated, and coached. He did no explaining that I could detect, nor did he perform any of the other mentoring functions. The mechanic who solved the problem of reattaching the exhaust pipe also played a mentoring role, demonstrating how to solve a problem neither Erik nor Schmidt had mastered.

One consequence of the obvious differences in scale and sophistication between this shop and the large one was that Erik's opportunities for learning were limited by his mentor's limited competence. Erik and Herr Schmidt struggled together for most of the morning to accomplish relatively routine tasks: replacing brake drums and installing a new exhaust pipe. It would have been unthinkable in the large shop to replace only part of an exhaust system because only part was in stock. Erik acknowledged the difficulty at one point, saying that the Land Cruiser was really more like a truck than an auto, a difference the large shop was prepared to handle.

Although the technical quality of teaching was limited, being in a small shop had the advantage of making Erik's relations with other mechanics more personal. The paternalistic gesture of the older mechanic providing Erik with his morning snack illustrates the closer, less formal social relations found in a small shop. With a full-time trainer in charge of apprentices and apprentices rotating through many different sections of the large shop, journeymen there were unlikely to feel such personal responsibility for

apprentices. This kind of relationship is quasi-parental; it carries the risk of being over-protective and insufficiently challenging to suit Erik's developmental status. At this stage in his training the gift of food could be considered a part of Erik's initiation, conveying the message that people here take care of each other. If it continued for another year or two it might undermine his maturation by depriving him of a sense of responsibility for himself.

B. Learner's Role

Erik exemplifies the traditional helper role of the apprentice in manual occupations. He was assigned to work regularly with one journey worker, but was also called on to help others as needed. Busy with helping tasks, he spent a larger proportion of time engaged in tasks that had little or no educational value, such as fetching food and stepping on brake pedals. Fetching Brotzeit is a traditional apprentice's task and remains so despite regulations banning it. The practice lives because it makes economic sense in small firms. Large firms, like the one just described, have their own cafeterias. Small firms cannot support such services. Since sending all the workers out to buy their food and beverages individually would be inefficient, the person whose time is least valuable is sent to do it; that person is invariably the apprentice. In contrast to Dieter, who was clearly a learner first and a worker second, Erik was first a helper. His experience as a helper was presumed to give him learning opportunities, but clearly interfered at times with learning.

C. Content

Less sophisticated work and a less competent teacher reduced the amount and quality of what Erik could learn in the shop about repairing automobiles.

Its smaller size and simpler structure also reduced the amount of learning he had to do about his workplace as an organization. When asked what he liked about his apprenticeship, Erik cited the firm's climate, saying he liked the friendliness of the people and the relaxed pace. Some of the organizational lessons Erik was learning were the opposite of Dieter's.

Another illustration of the difference between Erik's and Dieter's experiences was the incident of the mechanics exploring the traded-in Mercedes. In the larger shop, mechanics were insulated from the sales department. Given the division of labor, they would be unlikely to have an opportunity for such recreation. Their fooling around was mostly confined to the area where they waited for tools and parts.

Erik and Herr Schmidt engaged together in a series of problem-solving exercises: how to replace the brake drum, how to install the new section of the exhaust system. However, it seemed notably inefficient, consuming inordinate amounts of time. It was also constrained by the shop's resources, as when they were unable to install a complete exhaust system because it was not in stock.

D. Structure

Erik's helper role reveals the relatively loose structure of his training. Even on the basis of a single observation, one can infer that he would gain competence progressively as he encountered new experiences and mastered new situations, there was no indication that his work was planned to yield this progress systematically. The next time he encounters a Land Rover, he and his mentor will be better prepared, but such progress is incidental to the work rather than planned. Erik had no instructional shop, no full-time trainer, less variety of work, fewer tools, and less technical expertise.

Large vs. Small Shop

In the Berufsschule, both Erik and Dieter learned math in the form of machinists' calculations, science in terms of the metal and synthetic parts of automobiles. German and social studies contain references the auto industry, but are more generic. Their schooling also included shop instruction, supplementing that Dieter received in the workplace but providing Erik with his only general introduction to the specific kinds of tasks auto mechanics do. Vocational schooling is an important external support for West German apprentices' learning on the job. It is especially important as a source of continuity and progressive sequencing that is lacking in smaller firms.

If Dieter's and Erik's workplaces are compared as environments where they could learn to be competent auto mechanics, the large shop is clearly superior. However, it is also the case that each was being prepared to work effectively in a different kind of work organization. Erik's instruction was less thorough and expert, but so was the work done in his training shop. From the larger perspectives of educating and training West Germany's work force and providing young people with qualifications for entry-level work in many different firms, the large shop surely did a better job, but this should not obscure the small shop's value as a learning environment for someone likely to work in a similar shop as an adult.

Even more dramatic differences can be found between the kind of learning that is possible and appropriate in workplaces associated with different occupations. Especially useful for this purpose is the occupation, Industriekaufmann, a white collar occupation that embraces what in the United States are a number of different generic job titles, including bookkeeper, secretary (as distinct from a lower-level clerical worker), and personnel

officer.

A Large Industrial Firm

"Brandt," manufactures high quality products that it exports around the world. It makes a substantial investment in training apprentices for both manual and office jobs. I observed Eva Dietz, a first-year apprentice, at work in the firm's further education department, which is responsible for providing firm-based training to experienced employees. The office is located in a separate building in the large complex Brandt occupies. The complex is like a small city, with busses to move employees to and from the cafeteria and checkpoints at all the entrances to prevent unauthorized entry. During my visit, Eva engaged in three main activities: participating in a meeting, ordering a book, and sorting applications.

> Herr Franck, the director of further education, explains that he, two of his associates, and Eva are getting advice from a company expert on how to organize a file of materials related to seminars they give to employees. Eva will be responsible for setting up the file -- labelling folders and such -- but because the process is new to her she will mostly listen during the meeting.
>
> The meeting is proceeding as we enter the adjoining office. The expert, Herr Pflaum, does the most talking. He asks Eva whether she has seen the kind of file they are discussing, perhaps at a library. She says she has not. They talk about how to avoid losing materials when folders are removed. After agreeing on a schedule for initiating the work, Pflaum gives Eva detailed instructions about where to go to get the folders. Although Franck then appears to conclude the meeting, Pflaum shows no signs of leaving and talks a bit with Eva about her training. They discuss the potential future use of a computer to store the kind of information that will be in the planned file. Then Pflaum looks at his watch, rises with an, "Ach, gut," and the meeting ends with leave-takings.

The amount of time and number of people devoted to this topic was surprising to me, but I reflected that file cabinets are rare in Germany. In offices, at home, and at school, the standard method of organizing and storing papers is in loose leaf notebooks. Creating a vertical filing system was,

therefore, a less familiar task than it would have been in a U.S. office.

> The next phase of Eva's work occurs in Herr Franck's secretary's office across the hall. Interspersed with some copying, some discussion of how to tend the copying machine, and other short-term activities, Eva follows the secretary's instructions to fill out a book order form, slowly typing information from a publisher's flier. At one point, Eva has a question the secretary can't answer and goes to Franck's office. He can't answer it either but has a suggestion on how to proceed. A few minutes later, Eva brings her work to the secretary, who tells her what else to do. After about 40 minutes' work on the book order, Eva gets the secretary's approval and walks across the hall to get Herr Franck's signature.
>
> Eva then turns to the task of sorting employees' applications to take courses and seminars offered by the further education division. She finds it hard to decide on the proper categories and expresses her frustration to the secretary, who gives advice. The problem appears to stem from the vast number of choices, which are listed in two volumes totalling 450 pages.

Eva's morning combined a set of routine, low-level office tasks with participation in a meeting of managers. She was asked to make judgments about how to categorize applications. She was able to observe adults demonstrating both social and technical skills.

A. Mentor's Role

Like Dieter, Eva enjoyed the attention of multiple mentors. Behind those charged with instructing her on the job stood an apprentice supervisor who arranged her placements and assured the quality of her training and a full-time instructor who regularly taught such subjects as commercial law, bookkeeping, and typing in the firm's classrooms. Herr Franck was her instructor in this placement, but during the meeting Herr Pflaum played that role and then she worked under the direction of Herr Franck's secretary. Each one of these teachers seemed to take their role seriously and to devote adequate attention to it. Instruction and explanation were the dominant mentor functions. The meeting was a learning experience largely because of the demonstration the experienced employees provided.

B. Learner's Role

Eva was primarily a learner. Her slow typing and the 40 minutes it took her to fill out a book order form amply testify to her limited productivity at this stage of her training. Although some secretaries are trained as Industriekaufleute, Eva was not likely to become one. She was part of a small group of apprentices being trained by Brandt mainly for positions dealing directly with suppliers (Sachbearbeiter). Her time doing clerical work was intended to give her background for the more varied career ahead of her. Unlike Erik, she was not primarily employed as a helper for someone else.

C. Content

What was there for Eva to learn from this experience? She probably learned something about organizing a filing system. She should have noticed that arranging topics systematically is not a simple process, even though she would not be directly involved in that phase. But probably the more important

lessons had to do with social interactions. She witnessed an expert offering advice and non-experts asking for and making use of it. She saw deference to authority and examples of how to pose questions. As in most such transactions, small jokes and laughter were frequent and demonstrated how people seek personal connections and diversion in the midst of doing business. Overall, it seemed a useful introduction to life in a large corporation.

The second hour's work was clearly more routine, requiring few skills, though also making some demands on Eva that she could not meet without help. She had, therefore, to recognize when she needed help and how to ask for and make use of it. In addition to interacting with several people who came into the office briefly and with Herr Franck on the two occasions when she went to see him, she had the opportunity to listen to the secretary use the telephone with exceptional skill, conveying warmth and politeness along with information in calls lasting 20-30 seconds.

D. Structure

Like Dieter, Eva was beginning a process of rotating through a variety of placements in different sections of the firm, most lasting 10-14 weeks. These placements were planned to introduce her to a range of departments and jobs in the firm, and to progressively expand her repertoire of skills. Brandt maintains a suite of classrooms and a typing laboratory where Eva spent at least one morning each week. In addition, she and her colleagues attended vocational school on the "block plan," meaning that they attended full-time for five or six week periods rather than once a week for three years, which is standard practice. The purpose of the block plan is to sequence instruction in such a way that it can more readily be coordinated with work placements. Thus, Eva might study inventory procedures at school before taking her turn

doing inventory work at Brandt. Connections between school learning and work experience are closer as a result. However, they are not ideal. One of Eva's colleagues, when asked whether he used at work what he learned at school said the direction was more frequently reversed. Because his work experience and firm-based instruction were so rich, he often used in school knowledge he acquired at work.

The nature of the work done in Brandt's offices was quite different from the repair of automobiles. It called for less manual skill, more skill in working with people and data. Moving back and forth between Brandt and auto repair shops, I was constantly impressed by the differences in social relations at work. Auto mechanics work amid noise and oil, exchanging words briefly with their colleagues, usually on task-related matters, otherwise in a masculine kind of banter and horseplay. Industriekaufleute work in carpeted offices, wearing fashionable clothing, and constantly engage in social interactions that often mix task and interpersonal issues. Females are as prominent as males, though males are more likely to occupy superior positions.

A Medium-sized Industrial Firm

LDL manufactures sterilization equipment and furnishings for hospitals and laboratories. I visited its headquarters, where the main office and production plant are located. The personnel director assured me that LDL is internationally known in the field but, because the field is so small, not well-known by the general public. Its products are exported throughout Europe and the Middle East. Manufacturing processes are more complex than in many industries because many products are custom designed, as when the company builds and equips an operating room. On a smaller scale than Brandt, LDL represents the strength of West German industry: manufacturing high quality

goods for export.

Helga Frey is 17 and concluding her first year of apprenticeship with a term in the accounting department. She is older than some of her colleagues because she repeated a grade in order to move up from the lower to the middle-level secondary school (Hauptschule to Realschule).

> Helga's supervisor is Herr Huber, who will take charge of the accounting department when Herr Weiss retires in a few months. The three sit at desks pushed together in the center of a starkly furnished office. The only non-functional touches are a sprig of flowering shrub and one anemic plant on a window sill.
> Helga takes about 10 minutes to explain to me her task for the day. She is doing a Nachkalkulation, that is, summing all costs incurred in filling an order so that the actual cost of production can be checked against the projected cost. She consults a variety of documents in a notebook, tallies figures on a calculator, and enters the sums on a worksheet.
>
> In between his own work and answering Helga's questions, Huber explains to me that apprentices do not do cost projections (Vorkalkulation) because they do not remain in the department long enough to learn how. As Helga continues, with occasional questions for Herr Huber, she gives me her notebook to examine. It contains weekly reports on her activities in the firm and in her vocational school along with supporting documents and copies of related articles and citations to others. I learn from it that she has been at LDL for 10 months and worked in four departments. She has been in accounting for more than three months and will get a new assignment in two weeks.

When I interviewed her later in the day, Helga told me that Herr Huber had been quite nervous about my visit. She is his first apprentice and he wanted everything done right. He told her to do a Nachkalkulation even though her duties are often more routine and repetitious, such as eight hours of photocopying. However, she takes some pride in learning practical skills, contrasting her education with that of her two older brothers who are university students and have never worked an eight-hour day in their lives.

A. Mentor's Role

LDL's personnel director is responsible for organizing and supervising

Helga's training program. In view of his other responsibilities, he does not do any classroom teaching. Helga and her colleagues see the absence of instruction in the firm as one disadvantage they face compared to Industriekaufleute in larger firms.

Her immediate supervisor, Herr Huber, was proud of having earned the right to supervise apprentices. He explained to me that he was trained in an advanced vocational school (Fachoberschule) where he had two six-month practica rather than an apprenticeship. Not having been an apprentice himself, he would ordinarily not be allowed to train apprentices, but he took a special seminar and passed an examination that qualifies him to train apprentices in accounting, though not in other functions performed by Industriekaufleute (the plural, gender neutral form of Industriekaufmann). If his qualification to teach apprentices had been more easily acquired, he might have been less anxious about how he performed that role in my presence. Instruction and coaching were his primary functions.

B. Learner's Role

Helga's description of photocopying all day indicates that she does a good deal of helping that has only limited educational value. This kind of role for an apprentice was illustrated even better by the male apprentice in her firm, who was working in the mail room as a substitute while the regular person who did the job was on sick leave. He had little learning to do there because he had done the work before.

D. Structure

Although not as sophisticated as Brandt, LDL is a much more complex organization than the auto repair shop where Erik worked. There are many different sections and employees are both specialized and interdependent.

However, the sequence of apprentice experiences is not always purposeful. Nor can the personnel director devote the time and attention to apprentices' training that those in Brandt receive. Helga's studies in the part-time vocational school were not coordinated with her work assignments.

CONCLUSION

Implications for Practice

Scribner's plea for greater attention to the contribution of non-school settings to learning is not a new one. (See also Brown, Collins, & Duguid, 1989.) A small band of experiential educators has been supported by a much smaller band of researchers interested in the field (e.g., Conrad & Hedin, 1981; Hamilton, 1980; Moore, 1981; Owens & Owen, 1982; Newmann & Rutter, 1983). What she brings to the dialogue is some new insights from everyday cognition and higher order thinking that begin to provide a theoretical and empirical underpinning for the value of learning from experience and a set of principles for evaluating different out-of-school learning environments.

The purpose of this paper has been to add to that underpinning by examining the world's most elaborate system of experiential education: West German apprenticeship. Although it has cited some of the new work in everyday cognition, it is less informative than that line of research about what happens inside apprentice's heads. (See especially the work of Jean Lave on apprentice tailors in Nigeria.) Instead, they focus on the external conditions for learning, and especially the mentor's role.

If American educators and policy makers are to turn away from the familiar classroom setting and seek to create and exploit new opportunities for learning outside of schools, they must be guided by a set of principles that help them identify what a good learning environment might be and how it

could be used to promote different kinds of learning.

These case studies confirm the value of attending to the mentor's role, the learner's role, content, and structure. Those four elements, and the functions and issues related to each, provide a set of checkpoints and points of comparison that aid in evaluating the quality of several different kinds of workplaces as learning environments. The ultimate test, however, is what kind of leverage such an evaluation gives in improving teaching and learning in workplaces and equalizing access to learning on the job.

A. Mentor's Role

Using the term, mentor, to describe informal teachers and identifying the range of functions they perform helps to determine what high quality teaching might be. A mentor, by definition, performs multiple functions. The case studies suggest that, all other things being equal, more functions are better than fewer. Because all things are never equal, it is important to acknowledge that performing fewer functions would probably be preferable to performing all of them poorly. However, we did not observe that situation.

A mentor should not be identified as the only person responsible for teaching a new worker. On the contrary, West German apprentices who had both an on-the-job mentor and an overall supervisor for their training program appeared to benefit from that arrangement. In the best situations in large firms they also rotated among several mentors over the course of their training. And the beginning auto mechanics in the large shop began as a group with one mentor.

Where do mentors come from? Some are naturals. In West Germany, anyone who has formal responsibility for an apprentice's training program must be qualified. That person may turn over day-to-day supervision to a skilled

worker without special training, but retains ultimate responsibility. One part of the training that leads to the coveted title, Meister, is training in pedagogy, because a shop's Meister is responsible for apprentices. Without setting up a complicated system of training and certification, it would be possible to improve apprenticeship programs in the United States by paying more attention to the training and support of mentors. Support may be even more critical than training because it can be continuous and available when needed rather than provided only once. A number of mentoring programs have developed training programs and support systems that could be adapted. Training and supporting skilled workers as mentors for apprentices would be a new assignment for teacher trainers and corporate training divisions.

B. The Learner's Role

The optimal balance between work and learning is found in apprenticeship in large West German firms. Apprentices in smaller firms sometimes functioned as helpers more than learners, which limited their opportunities for learning. Standard practice in the United States is to place new workers immediately in productive roles, with only a brief period of learning before they are treated like other workers. While there are short-term economies to this practice and it will remain rational for relatively low-skill jobs like hers, training workers to higher skill levels requires a greater investment in training, which entails a shift in the balance.

C. Content

Including in the category of content both technical and social, explicit and implicit content seemed particularly useful. Apprentices had opportunities to learn about the structure and operation of their workplaces, but implicitly rather than as a result of explicit instruction. Recognizing

this tendency, Wagner and Sternberg (1986) label "tacit knowledge" the rules of thumb, tricks of the trade, and savvy about office politics that are seldom explicitly taught but may make the difference between a successful and an unsuccessful career. Attending to that domain of content may help to make otherwise hidden knowledge accessible to all.

There is a another dimension to content that the case studies revealed, which may be described in terms of a spectrum running from low-level to high-level content, of both the technical and social varieties. Low-level content includes the knowledge and skills a worker needs to perform routine tasks and to function within the firm's social structure under normal circumstances. High-level content is associated with problem solving, with operating effectively under novel circumstances. Problems occur both in the technical and the social spheres. A true expert is able to cope with unexpected events (Perkins & Salomon, 1989).

Some jobs require more training to achieve low-level routine competence than others. Nearly all jobs make occasional demands on higher-level expertise. Increasing reliance in American firms on teamwork, and on new practices such as quality circles increases the demands on employees' knowledge and skill levels. All workers certainly do not need as extensive training as West German apprentices receive, but more of them need training that is more thorough than a brief introduction to a single task.

D. Structure

It is difficult to organize an apprentice's work so that it constitutes a progressive sequence of tasks that call, in order, on what she or he has learned before. Perhaps the most daunting task is to connect work with formal schooling. It is attempted in West Germany but works best under the "block

instruction" plan, which remains rare. Building related instruction into a training program and providing opportunities for connection and reflection are partly matters of structure. They are also contributions that very good mentors can make.

Quality and Equality

Informal teaching and learning on the job assume a base of common goals and assumptions. Mentor and apprentice must be able to communicate readily with each other. They must hold each other in high esteem. Analyzing the process identifies some of the places where it may not work well, which serves the purpose of improving quality, but it also calls attention to issues of equality. In all the cases described above, mentors and young workers understood each other and maintained good interpersonal relations. If larger numbers of black and Hispanic males and of females are to work productively as skilled workers, many of them will be moving into jobs where white males have long been dominant. Their training programs must be designed with special care because trainers cannot assume that mentors will be able and willing to teach them as effectively as they have taught new workers in the past who were more like themselves. This is especially true in the often implicit social realm.

Although intensive and comprehensive training is desirable as a rule, not every firm is prepared or should be expected to provide training of such depth -- and expense -- to every employee. There must be a match between the amount and quality of training and the demands of a job. Training is costly, and employers must evaluate improvements in training by the same criteria as any other investment.

Implications for Research

The first need for further research is observation and interview data tracking on-the-job teaching and learning in a range of situations for an extended time. Short-term observations like those informing the case studies are of only limited utility in exploring a process that may unfold over a period of months or years. Ideally future research would observe teaching and learning on the job over much longer periods. Unfortunately, regular observations over a long period are very expensive. Systematically observing a range of workers at various stages of their training would be more efficient, but would not track continuity and sequence in an individual case. Asking mentors and apprentices to recall their key training experiences in interviews would help. It may be possible to find existing data sets that could be analyzed using the proposed framework, which would also increase efficiency.

A second direction for new research is achieving greater specificity, uniformity, and replicability in examinations of workplaces as learning environments. The kind of observations and interviews reported above are suitable for exploratory purposes, but must eventually be supplanted by more focussed and more systematic forms of data collection.

Third, as data collection becomes more systematic, it may also begin to include objective measures of what workers are learning. The best measures will be tests of performance, ideally under a range of situations to separate workers' ability to perform routine tasks from their ability to apply their learning effectively in novel situations.

Fourth, in addition to relating training experiences to work performance, it will be important to explore what happens inside the heads of new workers,

that is, how they cognitively and emotionally process their new experiences. In this, researchers in everyday cognition have shown the way.

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